O 32 Nanostrukturen III

Zeit: Montag 10:45–13:00 Raum: TU EB202

O 32.1 Mo 10:45 TU EB202

Quantendraht-Verhalten in einem metallischen Einkomponentensystem: monoatomare Cu/Cu(111)-Ketten — •Stefan Fölsch[1], Jérôme Lagoute[1], Per Hyldgaard[2], Fredrik E. Olsson[2], Mats Persson[2] und Klaus H. Ploog[1] — [1]Paul-Drude-Institut für Festkörperelektronik, Hausvogteiplatz 5-7, D-10117 Berlin — [2]Department of Applied Physics, Chalmers University of Technology, S-41296 Göteborg, Schweden

Mittels Tieftemperatur-Rastertunnelmikroskopie und -spektroskopie bei 7 K können monoatomare Cu-Ketten durch laterale Manipulation auf Cu(111) aufgebaut und hinsichtlich ihrer elektronischen Struktur charakterisiert werden. Für einzelne Cu-Adatome finden wir eine sp(z)-artige atomare Resonanz 3.3 eV über dem Fermi-Niveau [1]. In Cu-Ketten führt der Überlapp dieser Resonanzen zur Ausbildung von kettenlokalisierten Quantenzuständen, deren Dispersion vollständig durch ein eindimensionales (1D) Tight-Binding-Energieband einer Bandbreite von 1.8 eV beschrieben wird [2]. Die hier gefundene quasi-1D-Elektronendynamik in einem metallischen Einkomponentensystem stellt einen idealen Modellfall für einen Quantendraht dar, an dem der Effekt geknickter und verzweigter Drähte oder auch deren Wechselwirkung mit organischen Molekülen studiert werden kann. [1] F.E. Olsson et al., Phys. Rev. Lett. 93, 206803 (2004). [2] S. Fölsch et al., Phys. Rev. Lett. 92, 56803 (2004).

O 32.2 Mo 11:00 TU EB202

Kinks and junctions in assembled Cu/Cu(111) quantum wires studied by low-temperature scanning tunneling microscopy and spectroscopy — •Jérôme Lagoute, Xi Liu, and Stefan Fölsch — Paul-Drude-Institut für Festkörperelektronik, Hausvogteiplatz 5-7, D-10117 Berlin

Low-temperature STM-based atomic manipulation at 7 K was used to construct kinks and junctions in monatomic Cu chains on Cu(111). The juncture of these structures is stabilized by a compact Cu trimer while the extremities consist of close-packed monatomic Cu chains along the in-plane $\langle 110\rangle$ directions (Cu-Cu spacing 255 pm). Starting from the fact that straight Cu/Cu(111) chains exhibit chain-localized quantum states, we have studied the local density of states (LDOS) of these structures of advanced complexity by spatially mapping the dI/dV signal at constant tip height. We find that the LDOS and the eigenstate energies of kinked and branched wires are well described by the LCAO (local combination of atomic orbitals) approach. The wave function confinement in these structures and the electronic implications of the juncture will be discussed in detail.

O 32.3 Mo 11:15 TU EB202

Field controlled growth of nanoscale adsorbate layers — •Carsten Nowak[1], Guido Schmitz[2] und Reiner Kirchheim[1] — [1]Institut für Materialphysik, Friedrich-Hund-Platz 1, D-37077 Göttingen — [2]Institut für Materialphysik, Wilhelm-Klemm-Str. 10, D-48149 Münster

In the presence of strong electrostatic fields at the apex of needle-shaped substrates the formation of amorphous layers with a field-dependent stationary profile can be observed. We attribute this to the attraction of residual gas molecules to the tip due to polarisation.

For a quantitative evaluation we derived a local polarisation potential, describing the polarisation interaction between an uncharged molecule and the tip.

Comparison with the experiment reveals that the shape of the deposited amorphous layers corresponds to equipotential surfaces of the polarisation potential. The formation of a stationary profile, corresponding to a certain tip voltage, can be explained by the transition of the residual gas molecules from the physisorbed to the chemisorbed state and therefore by the necessity to overcome the activation energy of chemisorption.

As this process is restricted to regions of strongest curvature, probably this mechanism can be made responsible also for the growth of nanowires by deposition of molecular gases that has been reported recently [1].

[1] S.-W. Cheng and H.-F. Cheung. Role of electric field on formation of silicon nanowires. J. Appl. Phys., 94(2):1190, 2003.

O 32.4 Mo 11:30 TU EB202

Tip-substrate interaction at the atomic scale — •A.L. Klavsyuk, V.S. Stepanyuk, R.Z. Huang, P. Bruno, and J. Kirschner — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle, Germany

Performing atomic-scale simulations with ab initio based many-body potentials we demonstrate that the concept of size-dependent mesoscopic relaxations introduced for homo-and heteroepitaxy[1] should be used to describe the interaction of the STM tip with adatoms, nanoislands and steps at the atomic scale. We concentrate on Co adatoms, islands on Cu(001), and embedded Co atoms in Cu(100). Strongly inhomogeneous deformations of the substrate and islands are revealed when the tip approaches the surface. The shape of islands, tip and the substrate is found to strongly depend on the island size and the tip-island distance. We show that atomistic processes in the early stages of growth, such as the diffusion of an adatom on a flat surface and on top of islands, are strongly influenced by the tip. The possibility of controlling the dynamics of single adatoms exploiting the tip-substrate interaction is discussed. We reveal an essential role of the mesoscopic stress induced by the tip on a controlled movement of single atoms of Co incorporated in the surface.

[1] O.V. Lysenko, V.S. Stepanyuk, W. Hergert, and J. Kirschner, Phys. Rev.Lett. **89**, 126102 (2002)

O 32.5 Mo 11:45 TU EB202

STM characterisation and tip-induced nanostructuring of surface-frozen interfaces in a Ga-Bi alloy — •Andrey Turchanin[1,2], Alexander Issanin[1], and Werner Freyland[1] — [1]Institut für Physikalische Chemie, Universität Karlsruhe (TH), Kaiserstr. 12, D-76128 Karlsruhe — [2]Fakultät für Physik, Universität Bielefeld, Universitätsstr. 25, D-33615 Bielefeld

We report results of a UHV-STM study of the Bi solid/vapour interface in a solidified Ga-Bi alloy after passing a surface freezing transition. The topology at room temperature is characterized by extended monoatomic Bi terraces with dimensions up to several micrometers. We show for the first time that the application of negative/positive pulses of the bias voltage in the constant current mode results in modification of the Bi interface in the nanometer regime. Particularly unusual is the observation, that deposition and withdraw of Bi is possible by changing the pulse polarity. In this way different nanostructures (cavities, grooves, islands, lines etc.) can be produced. They show unusually high thermal stability at room temperature. For instance, monoatonic cavities with a diameter of 6 nm persist at the surface for at least three weeks. To rationalize the nanostructuring mechanisms different parameters have been studied including the threshold values of the applied pulses and their dynamics. An analysis of these different parameters will be given.

O 32.6 Mo 12:00 TU EB202

STM-Induced Electroluminescence with a Transparent ITO-Tip — •Robert Branscheid[1], Heiko Rochholz[1], Volker Jacobsen[1], Maximilian Scherff[2], Wolfgang Knoll[1], and Maximilian Kreiter[1] — [1]MPI für Polymerforschung, Ackermannweg 10, D-55128 Mainz — [2]Fachbereich Bauelemente der Elektrotechnik, Fernuniversität Hagen, Haldenerstr. 182, D-58084 Hagen

A homebuilt STM combined with an efficient optical detection has been used to investigate photon maps of nano-structured gold substrates and disc-shaped single-particles. Common metal tips like Pt/Ir or W often show photon emission consistent with topographical features but presence of the metallic tip 'felt' by the sample provokes a strong influence on photon emission. Additional distortions caused by multiple-tip phenomena make a correct interpretation almost impossible. Therefore a dielectric tip consisting of indium doped tin oxide (ITO) has been compared with Pt/Ir. This material is assumed to be transparent for optical fields and should thus lead to less tip-induced modifications. As substrate nano-structured triangle patterns have been used showing a plasmon induced field enhancement. Furthermore disk-shaped gold particles have been investigated and isochromat photon maps have provided additionally spectral information.

O 32.7 Mo 12:15 TU EB202

Building Planar Molecular Networks by Polymerization — •Markus Wahl[1], Meike Stöhr[1], Thomas A. Jung[1,2], Hans-Joachim Güntherodt[1], and Lutz H. Gade[3] — [1]Institute of Physics University of Basel, Switzerland — [2]Paul-Scherrer-Institut, Villigen, Switzerland — [3]Institute of Anorganic Chemistry University of Heidelberg, Germany

Self-assembly of molecules on surfaces directed by different supramolecular interactions has been widely explored. Our aim is the formation of covalently linked planar structures by means of polymerization confined in one or two dimensions.

Recent experiments with a perylene derivative (DPDI) using differential thermoanalysis and gravimetry demonstrated that bulk DPDI can polymerize releasing ammonia. Inspired by this observation, we formed covalent networks on metallic surfaces and checked the feasibility of such an approach for the formation of other stable polymer-nanostructures.

For this purpose, thin films of DPDI were prepared on Cu(111) by evaporation in a UHV setup. The molecular arrangements were analyzed with a home-built STM. For a coverage of 1ML DPDI a 1D polymer chain pattern was observed after annealing the sample to 580K. For lower coverage in the range of 0.3 ML only a mobile phase was detected before annealing. However, upon annealing a stable 2D network with a honeycomb-like structure was observed which conveniently matches the angles and distances expected for the chemically feasible polymer structure.

O 32.8 Mo 12:30 TU EB202

Copper-phthalocyanine/Cu(001) as template for cobalt- nanodots — •C.X. Liu, H. L. Meyerheim, J Barthel, and Jürgen Kirschner — Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, D-06120 Halle

Preparation of metallic nanostructures require a special template for preferential adsorption. While for this purpose vicinal surfaces or dislocation networks are used quite frequently, large organic molecules deposited on flat substrate surface have only recently attracted interest[1]. Here we show that copper-phthalocyanine (CuPc) molecules deposited on Cu(001) at room temperature can be used to prepare a suitable template for preparing a metallic nanostructure. Depending on the CuPc-coverage we find different CuPc-superstructures. A "relaxed"one at a coverage of one monolayer (i.e. a complete layer of molecules), which we assign to a quadratic (5 3 -3 5) unit-cell in matrix notation, and a "compact"one corresponding to a coverage of about 1.5 monolayers. For the latter, STM indicates the formation of a stripe structure, where the stripes are formed by molecules aligned in columns parallel to the $< 110 >$ substrate directions. The stripes are up to 100 nm long, their lateral separation (1.3 and 2.6 nm) gives rise to a (10x1) LEED-diffraction pattern. Subsequently deposited Co ($\approx$ 0.3-0.5 ML; $1ML = 1.53 \times 10^{15} atoms/cm^2$)is found to adsorb in monolayer thick islands (diameter $\approx$ 5nm) aligned parallel to the stripes keeping the short range ordering intact. Magnetic hysteresis loops are observed in longitudinal geometry above about 0.5 ML at 50K.
[1] X. Ma, et al., Appl. Phys. Lett. **84** (2004) 4038

O 32.9 Mo 12:45 TU EB202

One dimensional metal-organic chains on Cu(110): Cu-TMA (trimesic acid) and Fe-TMA — •Thomas Classen[1], Giovanni Costantini[1], Frank Stadler[1], Cheolkyu Kim[1], Klaus Kern[1], Guido Fratesi[2], Stefano Fabris[2], Stefano de Gironcoli[2], and Stefano Baroni[2] — [1]Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart — [2]SISSA and INFM DEMOCRITOS National Simulation Center, Via Beirut 2-4, I-34014 Trieste, Italy

One dimensional (1D) metal-organic coordination networks have been created on Cu(110) using self-organized growth. Trimesic acid (TMA) and Fe have been deposited in ultra-high-vacuum (UHV) by means of organic and conventional molecular beam epitaxy respectively. TMA deposition on Cu(110) results in the formation of metal-organic chains with Cu adatoms supplied from the step edges. The chains are mono-disperse and are oriented along the $\langle 1\bar{1}0 \rangle$ substrate direction. By deposition of Fe also Fe-TMA chains were produced with a noticeably different morphology. Both chain types have been investigated using variable temperature scanning tunnelling microscopy in UHV and density functional theory in the generalized gradient approximation (DFT-GGA). The DFT-calculations predict a spin-polarization for the Fe atoms in the Fe-TMA chains. This opens the possibility to study a low dimensional magnetic system thermally stabilized by organic linker molecules.